Alaska Forum on the Environment
2014

Environmental Contaminants: Alaska Fish Monitoring Program

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Fish Monitoring Program:

Determine if Alaska's seafood and freshwater fishes have been negatively impacted by contaminants and monitor data trends

- **General Survey of Alaskan Fishes:**
  - Commercial , Subsistence, Recreational species
  - Opportunistic sampling- cost saving approach
    - Samples collected at commercial, recreational and subsistence fish harvest sites

- **Selected coastal sites:**
  - Adjacent to anthropogenic activities: cities, discharges/runoff
  - Historic mining sites

Fish Monitoring Program:

- Data is used to:
  - Determine if there are any areas, species, or contaminants that warrant more in-depth sampling and evaluation.
    - Can be used to evaluate Water Quality
  - Provide Alaskan residents with information to make an informed dietary decision based on Risks and Benefits of eating Alaskan Fish
  - Respond to National Fish Consumption Advisories

Fish Consumption Advisories

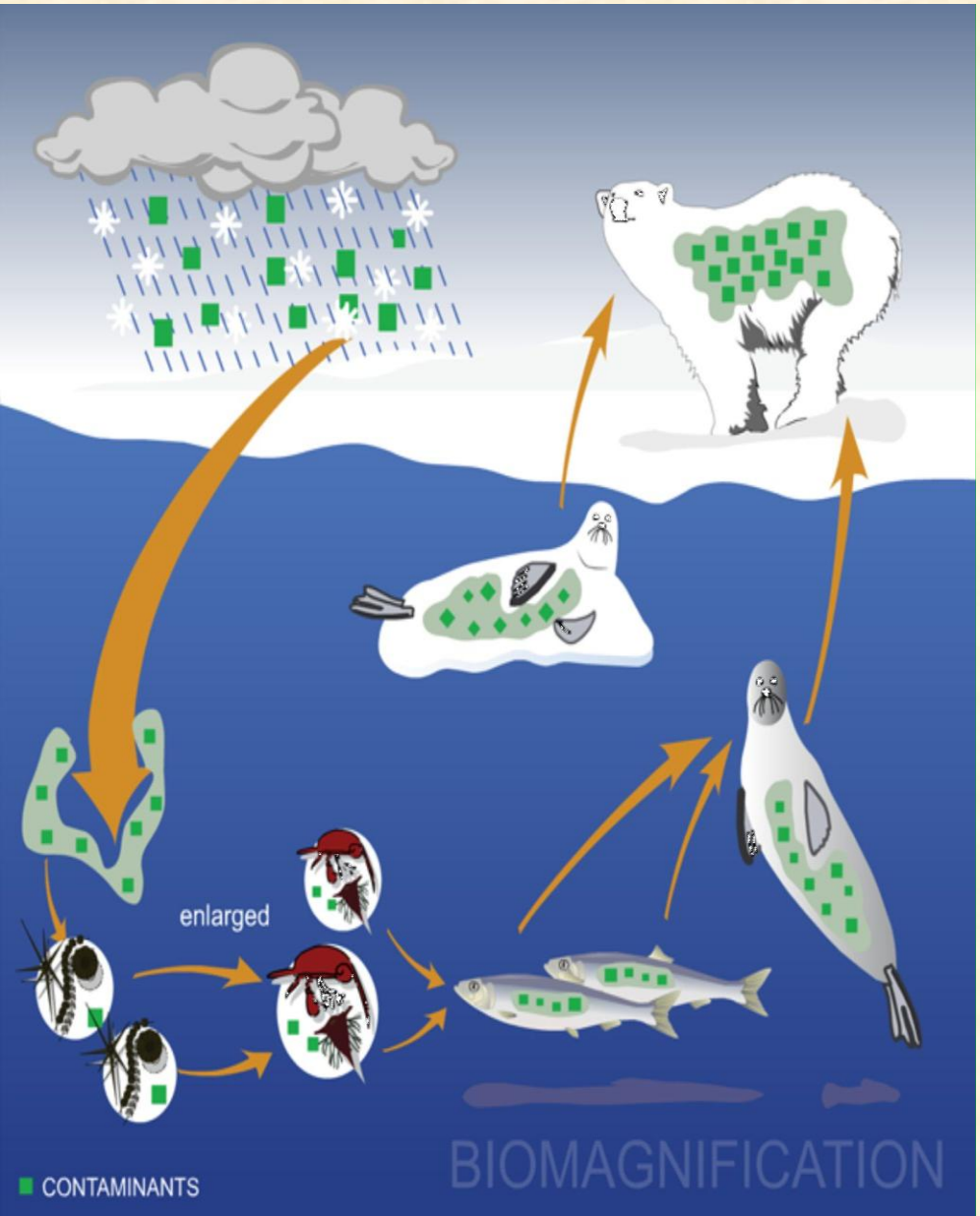
- Goal is to protect public health but can be **confusing**:
  - National recommendations by EPA, FDA, ATSDR
  - International recommendations Canada, WHO
  - State and Local Advisories
- Can be **confused** with Water Quality Standards (WQS)
  - Fish Consumption Rate, Human Health Criterion
  - Goal of WQS are to protect water resources
- Fish are a highly nutritious food, a complex of nutrients and some fish may contain contaminants. Consumption Advisories evaluate the health risks vs. the health benefits of eating fish.

Target Analytes

Persistent Bioaccumulative Toxins

- **Heavy Metals:**
  - Mercury: Total Mercury, Methyl-Mercury
  - Arsenic, Cadmium, Chromium, Copper, Nickel, Lead, Selenium
- **Organochlorine Compounds:**
  - PCBs
  - Dioxins and Furans
  - Pesticides (Organochlorine Pesticides)
- **Emerging Contaminants:**
  - Brominated Fire Retardants (PBDE)
  - Poly-Fluorinated Compounds (PFC, PFOS, PFOA)
  - Pharmaceuticals, personal care products

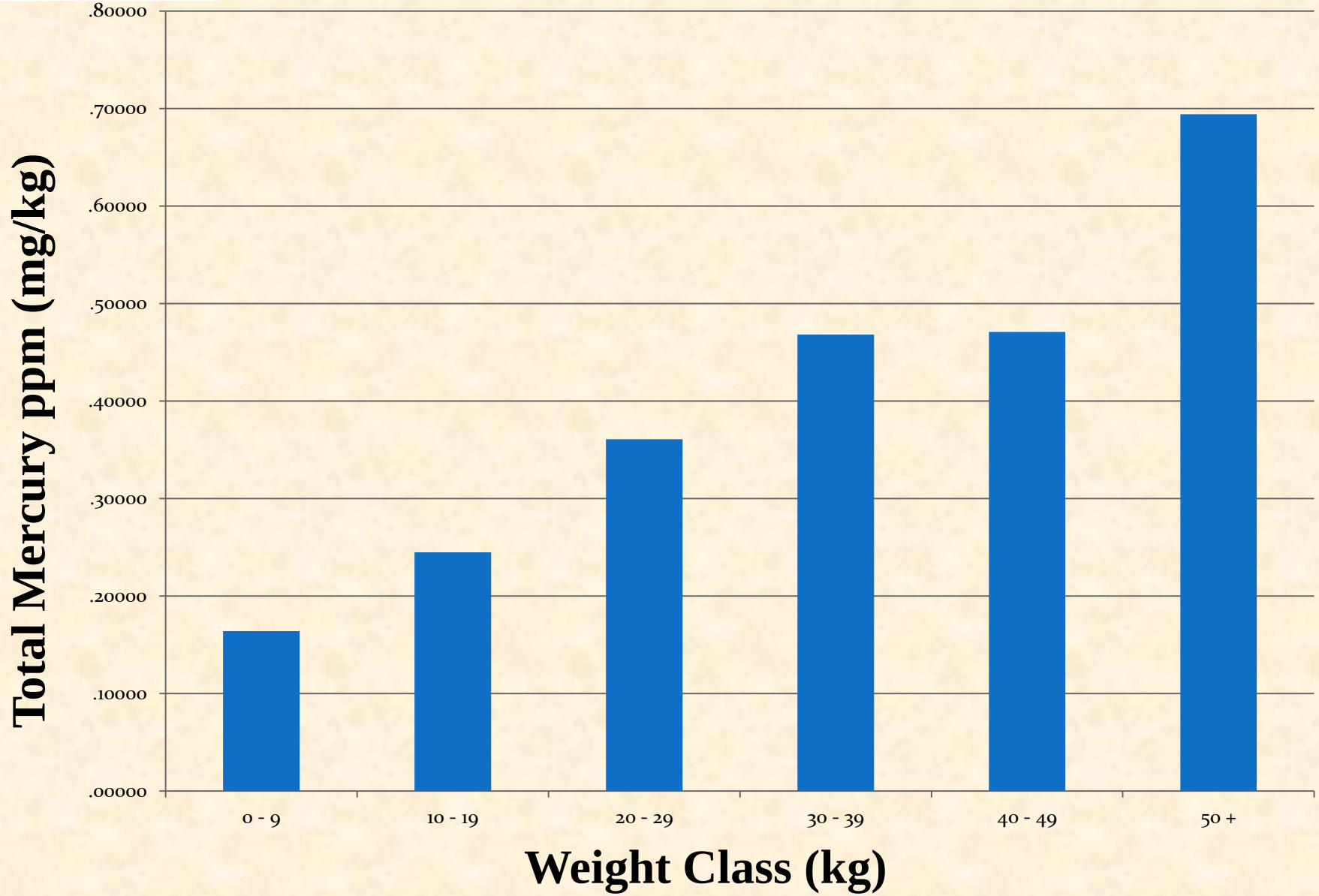
Bioaccumulation/Biomagnification



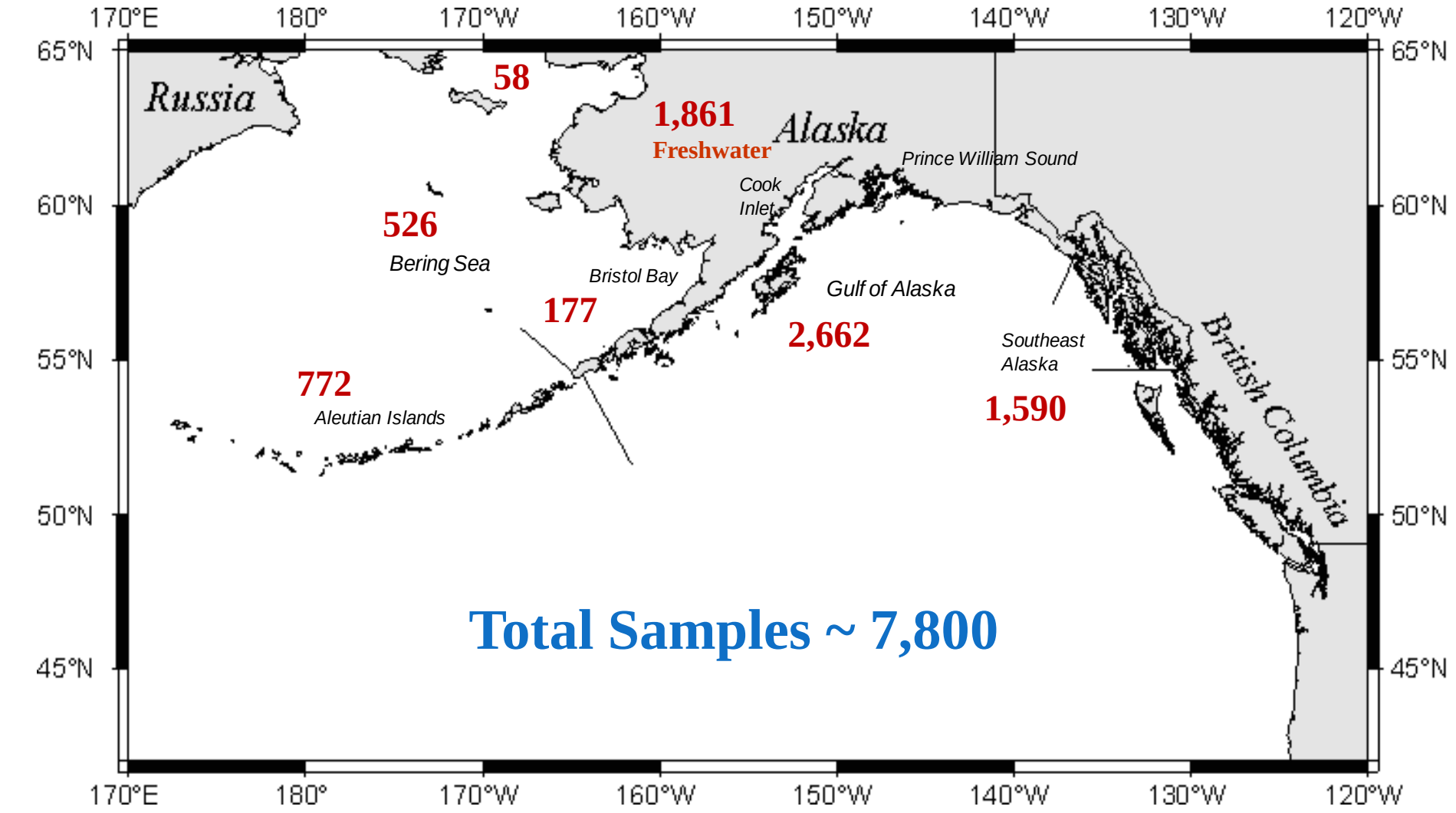
Bioaccumulation – increase in the concentration of a compound over time as the animal gets older/larger. Chemical accumulates faster than the animal can eliminate it.

Biomagnification – increase in the concentration of a substance or chemical up the trophic feeding level

Halibut: Mean THg/weight (kg)



Areas Fish Were Collected for the DEC Fish Monitoring Program



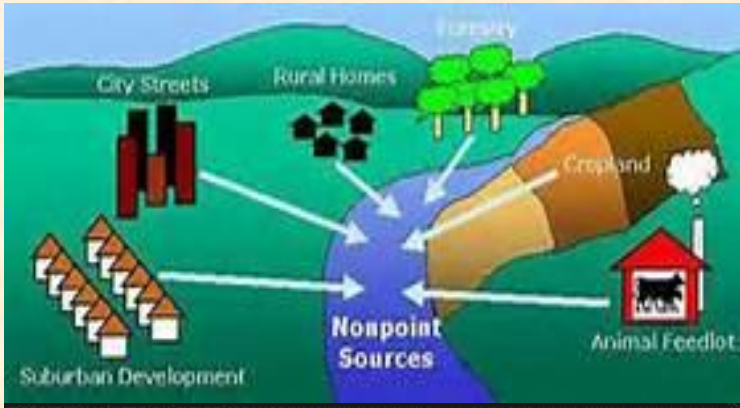
Number of Fish Samples per Region

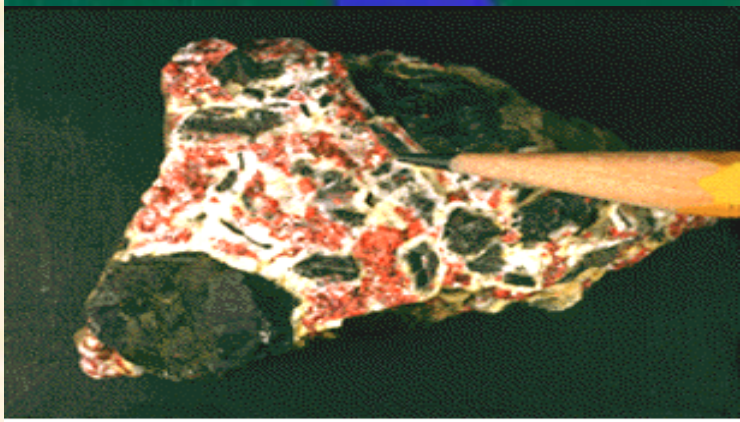
Fish Monitoring Program

ATKA MACKEREL	10
BURBOT	27
CAPELIN	45
CHAR-ARCTIC + DOLLY VARDEN	50
CRABS	368
CISCO	47
CLAMS, COCKLES, CHITON	359
COD	195
EULACHON (Candlefish)	35
GEODUCK	132
GRAYLING	47
GREENLING	45
HALIBUT	1919
HERRING	32
IRISH LORD-RED	19
IRISH LORD-YELLOW	14
LAMPREY	10
LINGCOD	230
LONGNOSE SUCKER	3
MUSSELS, BLUE	44
NORTHERN PIKE	572
OCTOPUS-SQUID	12
OYSTERS-SCALLOPS	141
POLLOCK	195
ROCKFISH-BLACK	79
ROCKFISH-DUSKY	66
PACIFIC OCEAN PERCH	83
ROCKFISH-YELLOWEYE	116
ROCKFISH SPECIES	66
SABLEFISH	249
SALMON-CHINOOK	479
SALMON-CHUM	302
SALMON-PINK	188
SALMON-RED	401
SALMON-SILVER	664
SAND LANCE	47
SHARK	111
SPINY DOGFISH	52
SHEEFISH	16
SKATE	186
SOLE	27
STICKLEBACK	61
TROUT-LAKE	124
WHITEFISH	142

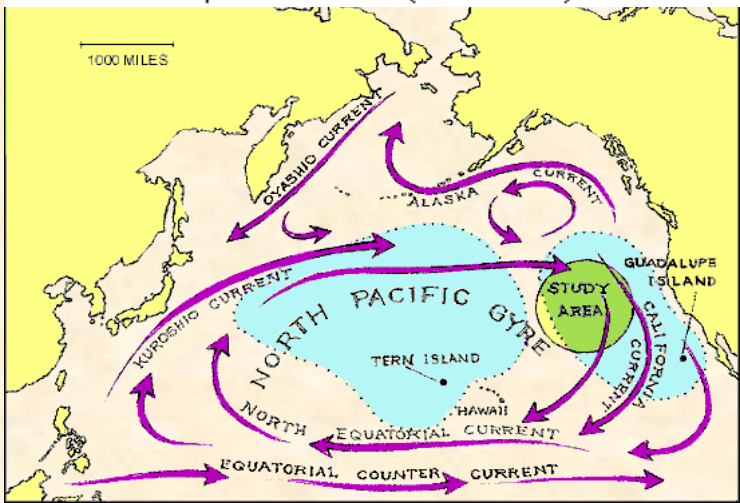
Sources

- Local
  - Cities and Industrial production
  - Natural Geologic sources
  - Military Sites
  - Resource Extraction-
    - mines, oil exploration
- Long Range Transport
  - Atmospheric
  - Ocean Currents
  - Animal migration
  - Commercial transport





Sample of cinnabar (red mineral)



Pharmaceuticals + Personal Care Products (PPCP)

- Personal health care + cosmetic products, prescription and over-the-counter drugs, veterinary drugs
- Studies have shown that PPCPs are present in our nation's waterbodies.
- Detection at very low levels in fish
- No evidence of adverse human health effects from PPCPs in the environment
- But they may act as a stressor on certain organisms in the ecosystem from bacteria to aquatic animals

PPCPs

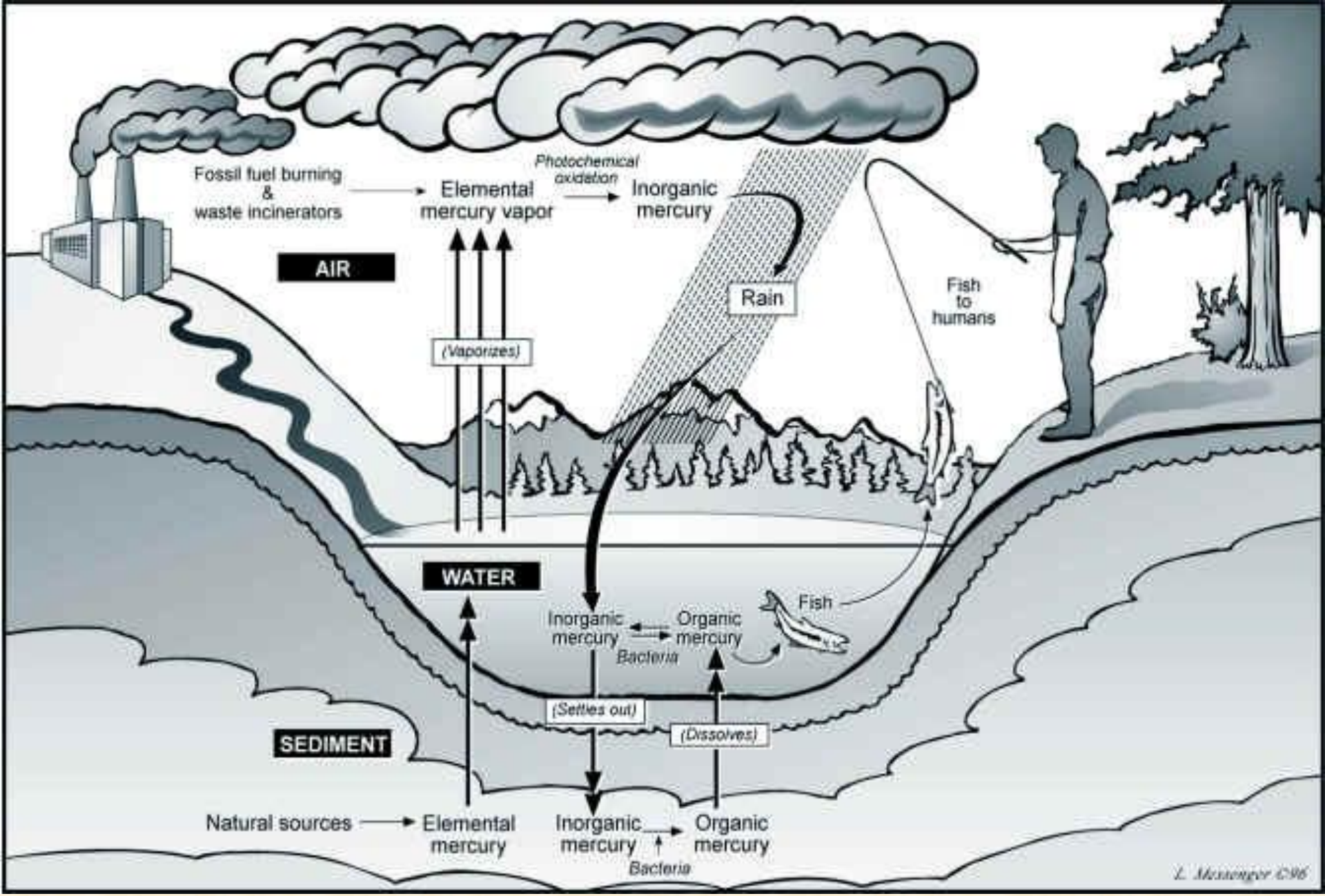
1,7-Dimethylxanthine	Clarithromycin	Hydrocodone	Propoxyphene
10-hydroxy-amitriptyline	Cocaine	Hydrocortisone	Propranolol
4-Epitetracycline	Cotinine	Ibuprofen	Ranitidine
Albuterol	DEET	Lincomycin	Sertraline
Alprazolam	Dehydronifedipine	Meprobamate	Simvastatin
Amitriptyline	Desmethyldiltiazem	Metformin	Sulfadimethoxine
Amlodipine	Diazepam	Methylprednisolone	Sulfamethazine
Amphetamine	Digoxigenin	Metoprolol	Sulfamethoxazole
Atenolol	Diltiazem	Miconazole	Tetracycline
Atorvastatin	Diphenhydramine	Naproxen	Thiabendazole
Azithromycin	Doxycycline	Norfloxacin	Triamterene
Benzoylecgonine	Enalapril	Norfluoxetine	Triclocarban
Benztropine	Erythromycin-H2O	Norverapamil	Triclosan
Caffeine	Fluoxetine	Ofloxacin	Trimethoprim
Carbamazepine	Furosemide	Oxycodone	Valsartan
Cimetidine	Gemfibrozil	Paroxetine	Verapamil
Ciprofloxacin	Hydrochlorothiazide	Promethazine	Virginiamycin
		Propoxyphene	Warfarin

Total PCBs (ppb)

	Salmon			Salmon near Waste Water Discharge	
	N	Mean ± SD		N	Mean ± SD
Fry Composite	17	14 ± 21		3	43 ± 28
Fillet	67	7.1 ± 5.6		5	5.4 ± 2.9
Whole	17	7.8 ± 3.3		5	6.4 ± 1.6

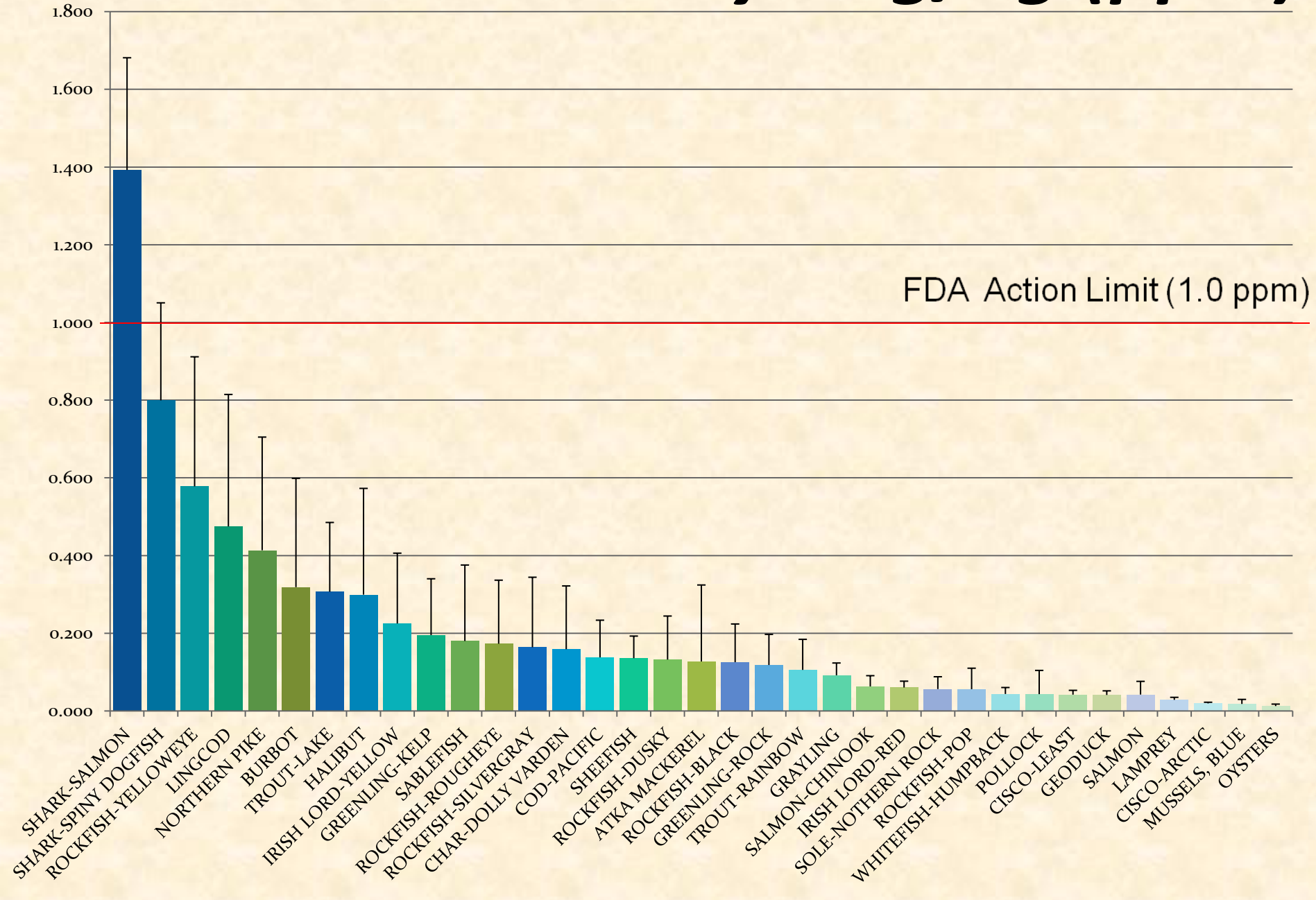
Pesticides (ppb)

		Salmon		Salmon near Waste Water Discharge
Fry Composite Sample	Chlordanes	1.6 ± 0.84		0.64
	DDT	6.2 ± 2.8		3.0
	Hexachlorobenzene	0.33 ± 0.18		0.13
	Lindane and HCH	0.71 ± 0.96		0.10
	Total Toxaphene	3.7 ± 3.0		1.2



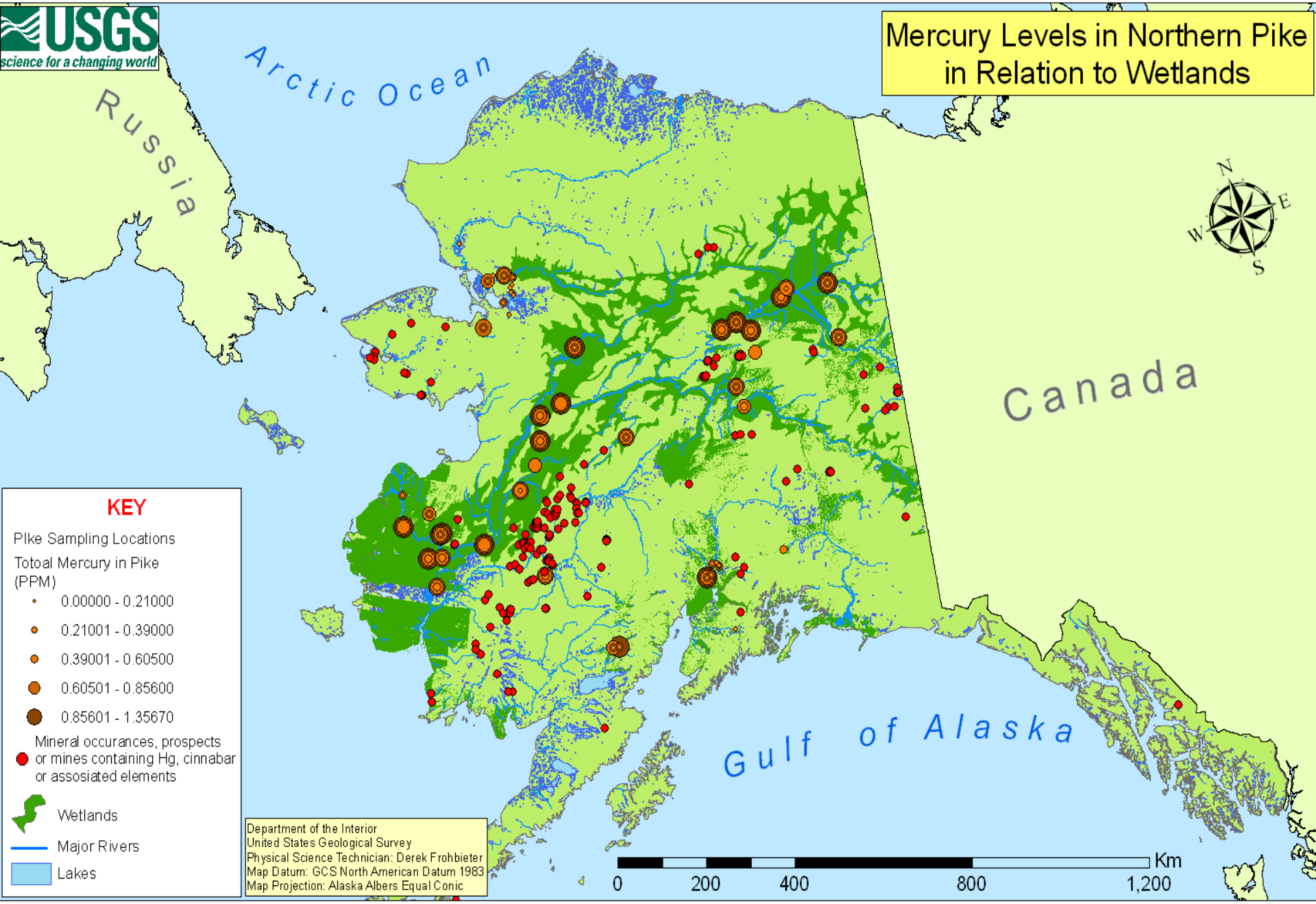
Mercury Cycle

Mean Total Mercury: mg/kg (ppm)



Resource Extraction

geologic deposits – gold, mercury, trace metals


USGS
science for a changing world
Mercury Levels in Northern Pike in Relation to Wetlands
Arctic Ocean
Russia
Canada
Gulf of Alaska
N
S
E
W
KEY
PIke Sampling Locations
Totoal Mercury in Pike (PPM)
0.00000 - 0.21000
0.21001 - 0.39000
0.39001 - 0.60500
0.60501 - 0.85600
0.85601 - 1.35670
Mineral occurances, prospects or mines containing Hg, cinnabar or assosiated elements
Wetlands
Major Rivers
Lakes
Department of the Interior
United States Geological Survey
Physical Science Technician: Derek Frohbieter
Map Datum: GCS North American Datum 1983
Map Projection: Alaska Albers Equal Conic
0
200
400
800
1,200
Km

Long Range Transport

Atmospheric Mercury

Sources : - Anthropogenic (80%)

- Natural (20%)

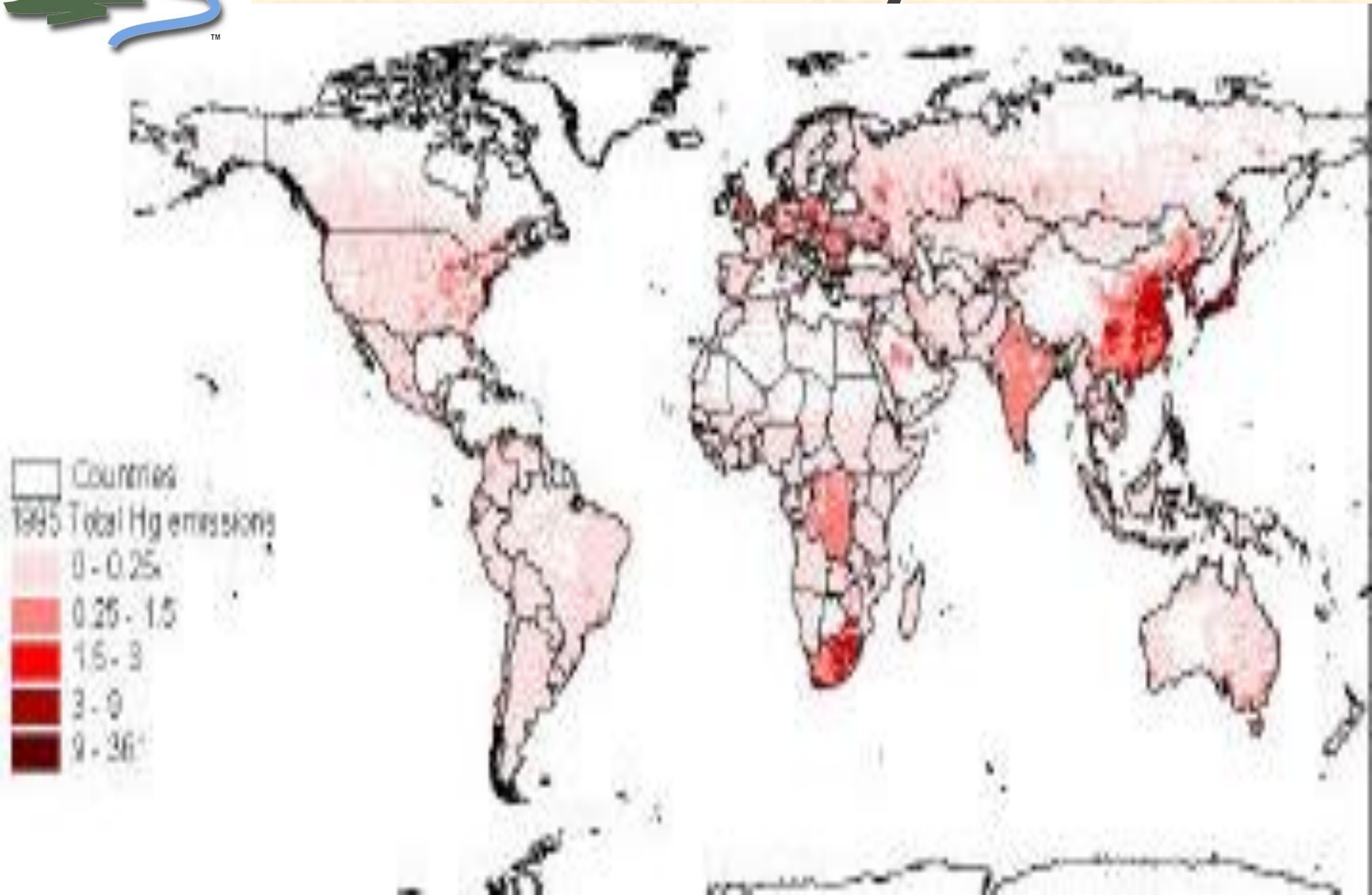
Chemical Forms of Mercury and Residence Time

Gaseous Elemental Hg: ~ 1 year

Reactive Gaseous Hg: minutes-weeks

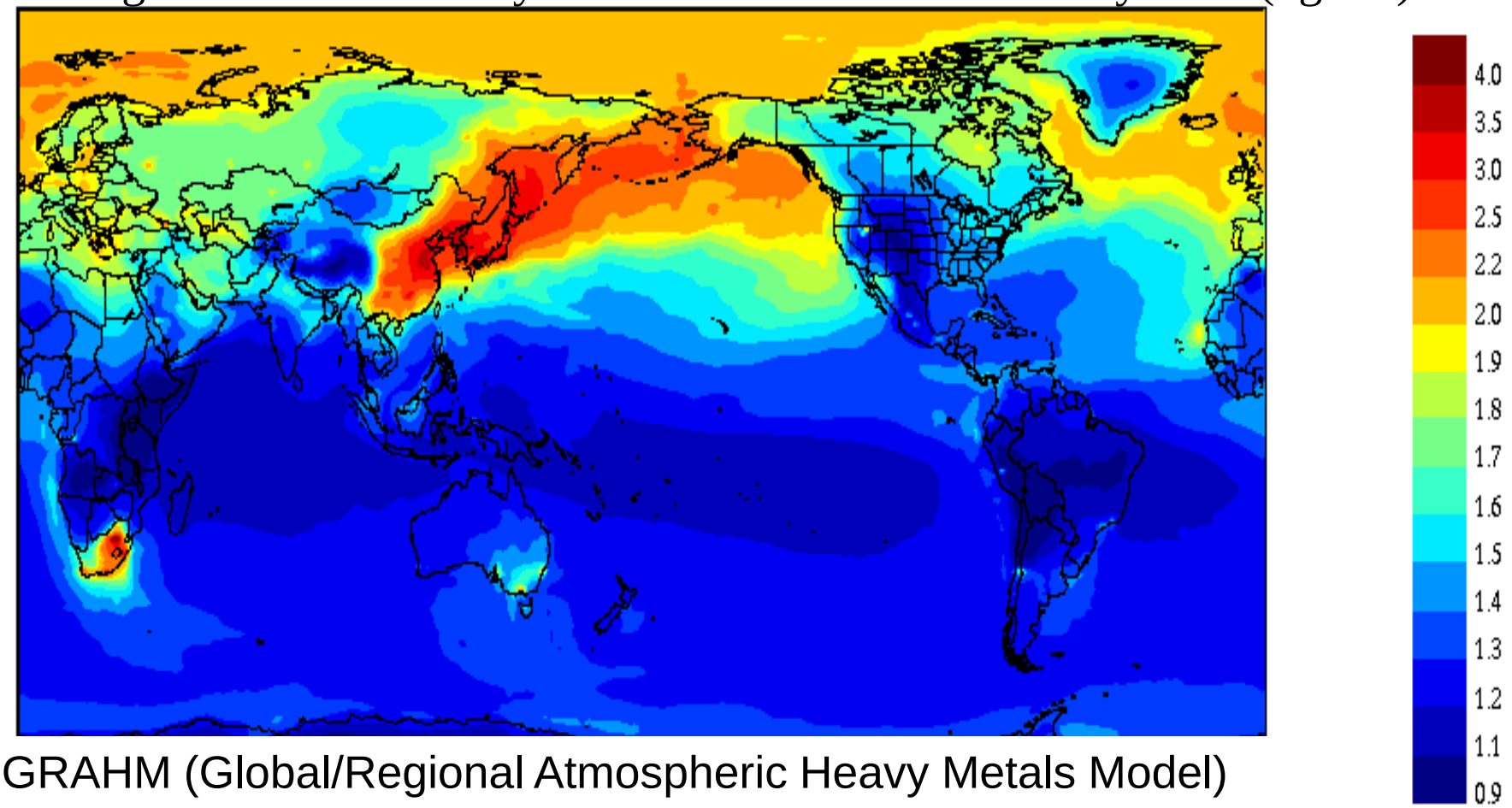
Particulate Hg: minutes-weeks

Global Mercury Emissions



Global transport modelling

Average elemental mercury surface concentrations for July 2001 (ng/m3)

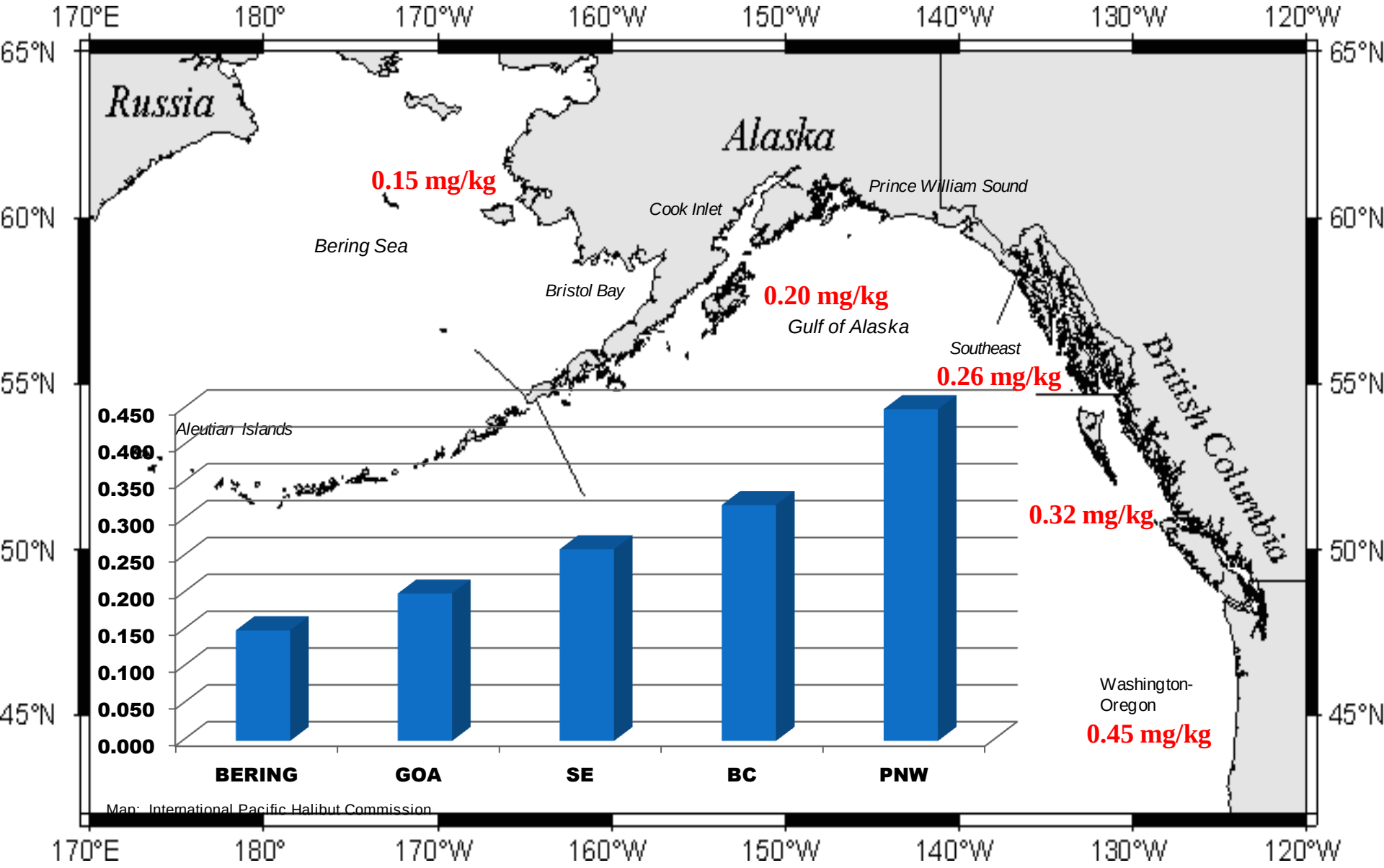


GRAHM (Global/Regional Atmospheric Heavy Metals Model) simulation – Ashu Dastoor, Meteorological Service of Canada,Environment Canada

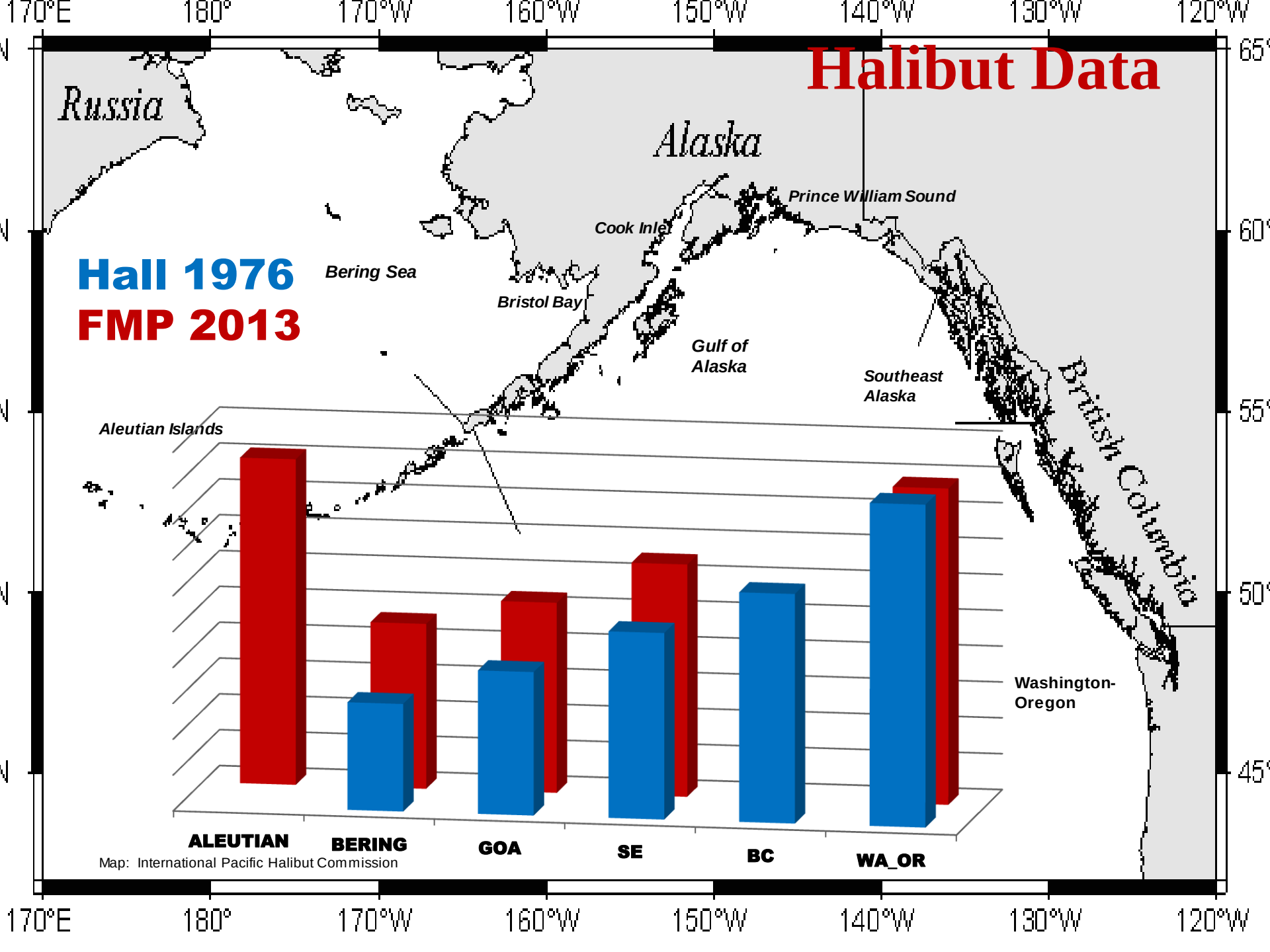
Regional Differences in Mercury concentration in fish tissue

- NOAA study (Hall, et.al. 1976)
  - Total Mercury Concentration (skinless fillet)
  - Regional comparison:
    - Eastern Bering Sea
    - Gulf of Alaska
    - South East Alaska
    - British Columbia
    - Washington-Oregon

NOAA 1976 Hall et. al. Study



Halibut Data



Map: International Pacific Halibut Commission

Alaska Forum on the Environment 2014

- **Complex Issue:**
  - Varied sources of Environmental Contaminants
  - Site specific and regional differences
  - Possible Impacts on ecosystem health
    - Water quality
    - Animal health – food quality
    - Public health
  - Need for monitoring to determine presence and evaluate trends
  - Need for clear information to the public

Thanks to our collaborative partners

This project is supported with CIAP Funding